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The role of beliefs, trust, and risk in contributions to a public good*

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Abstract: This paper experimentally investigates the role of beliefs, trust, and risk in shaping cooperative behavior. By applying incentivized elicitation methods to measure these concepts, we find that beliefs about others' behavior and trust are positively associated with cooperation in a public goods game. However, even though contributing unconditionally to a public good resembles a situation of making decisions under risk, elicited risk preferences do not seem to explain cooperation in a systematic way.

JEL Classification: C91, D03, D64.

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1. Introduction

Many situations in our daily lives possess properties of a public good (synonymously called a social dilemma). Examples range from teamwork over paying taxes or voting to the use of common goods. Being non-rival and non-excludable, public goods are plagued by free-riding problems in theory. However, a majority of involved agents do not free-ride in the provision of a public good, even when it is a dominant strategy for a rational and selfish individual to do so. Both in the field and in the experimental laboratory, we observe considerable heterogeneity with respect to cooperative behavior across people. At present, little is known about the determinants that shape cooperative behavior in social dilemmas and especially about the connection of cooperative behavior with obviously related behavioral tendencies such as trust or risk attitudes. In this paper, we investigate the driving forces behind cooperation by using a standard public goods game in the experimental laboratory. More specifically, as far as we are aware, we are the first to provide a complete and entirely incentivized anatomy of the association between cooperative behavior, trusting behavior, trustworthiness, beliefs, and decision-making under risk.

Each of these links has been studied before in the experimental literature separately and subsets of them in combination. Recently, Thöni *et al.* (2009) investigated both self-reported trust and beliefs about others' contributions in an experiment among the Danish population and found that self-reported trust explains cooperative behavior to a significant extent. There is further evidence by Leonard *et al.* (2010), based solely on self-reported contribution behavior, that shows an association between trust and cooperation. Even earlier, Gächter *et al.* (2004) found a positive and significant effect of self-reported trust questions related to beliefs about people's fairness, helpfulness and trust in strangers on contributions in a public goods experiment. However, they found no significant effect of the stated trust question on the actual trusting behavior.[1] On the other hand, Anderson *et al.* (2004) provided mixed evidence regarding the correlation between cooperation and self-reported trust in different domains of trust.[2]

[1] It is a debated issue whether trust elicited in a trust experiment correlates with trust reported in surveys. Glaeser *et al.* (2000) compared results from trust experiments and stated trust and found poor correlations between the amounts sent in the trust experiment and stated trust. They concluded "that most work using these survey questions needs to be somewhat reinterpreted" (p. 814). On the other hand, for example, Fehr *et al.* (2002) and Bellemare and Kröger (2007) found a significantly positive relationship.

[2] The relationship between trust and cooperation has been discussed in other fields for decades (e.g., Deutsch, 1958; Dawes, 1980). More recently and more generally, economists have established the importance of trust

Contributing to a public good without knowing how much other group members are going to contribute can be viewed as a risky decision. Therefore, risk preferences might influence contributions to a public good. More risk-averse individuals might choose to contribute less to the public good to compensate for the risk of others not contributing. However, this type of risk is a *social risk* (the risk that originates from the decisions of other human beings) rather than a *natural risk* (a random event, independent of human decisions). There is some evidence that humans perceive those risks differently but that attitudes towards social risk and natural risk are correlated (e.g., Bohnet *et al.*, 2008). Most existing studies relating risk and contributions to public goods use a measure of natural risk. In line with the notion that risk affects contributions to a public good, Charness and Villeval (2009), for instance, found that subjects who invested more in a risky asset contributed less to a public good. A similar result has been reported by Sabater-Grande and Georgantzis (2002), based on a multi-period prisoner's dilemma game.

Risk may also indirectly influence contributions as indicated by a few recent experiments that have focused on whether trust itself is determined by natural risk preferences. However, existing experimental results on the association between trust and natural risk are inconclusive. Whereas Schechter (2007) found a correlation of individual behavior in a trust game and a risk experiment in rural Paraguay, Bahry and Wilson (2004) and Eckel and Wilson (2004) did not find any relationship between elicited risk attitudes and the amount sent in a trust game.

Our experiment consists of three main parts that measure (i) cooperative behavior and beliefs about others' contributions to the public goods, (ii) (natural) risk preferences, and (iii) trusting behavior as well as trustworthiness. All measures are fully incentivized. Cooperative behavior is elicited by using a one-shot public goods experiment, which has the advantage of eliminating strategic motives. We apply the experimental design introduced by Fischbacher *et al.* (2001) based on the strategy method. It elicits conditional contributions, i.e., how much a subject wants to contribute conditional on all possible average integer contributions by the other members in the subject's group, in an incentive-compatible way and allows us to classify cooperation types. The two predominant types are free-riders and conditional cooperators. We also included an incentivized question on beliefs about others' average

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especially for economic growth (e.g., Knack and Keefer, 1997; Knack, 2002). Whereas the literature includes many definitions of social capital (see, e.g., the overview in Durlauf and Fafchamps, 2005), several emphasize trust as a key component (e.g., Bowles and Gintis, 2002; Putnam, 2000).

contributions. Moreover, our subjects participate in a risk experiment using the same design as in Holt and Laury (2002) to elicit their attitudes toward natural risk and in a trust game similar to the design used by Berg *et al.* (1995) to elicit trusting behavior and trustworthiness.

The results of our study indicate that beliefs about others' contributions and trust as elicited by the trust game are significantly associated with the contribution of public goods and cooperative behavior, whereas (natural) risk preferences do not affect contributions or trusting behavior in a systematic way. Whereas the former association is not unexpected, given existing empirical results, the lack of association between natural risk and cooperation as well as the lack of association between natural risk and trust are noteworthy. Our measure of natural risk seems unable to explain any kind of social risk in either the public goods game or the trust game. Furthermore, from the combination of individual contributions to the public good, individual beliefs on others' contributions and individual conditional contributions to the public good, we know that subjects do not perceive the contribution to a public good as risky at all.

The remainder of the paper is organized as follows. Section 2 describes the design of our experiment. The following section presents the results, and, finally, Section 4 concludes the paper.

2. Experimental design

Our experimental design consists of three different parts conducted in the following order: (i) a one-shot linear public goods experiment with the strategy vector method as well as an elicitation of beliefs on others' contributions, (ii) a risk attitude elicitation experiment, and (iii) a trust experiment. The decisions in all parts were monetarily rewarded, and it was clearly stated that the parts were independent of each other. Feedback was only given at the end of the experiment to avoid any cross-contamination of parts. The experimental instructions that we used can be found in Appendix A. All of the procedures described in the following were common knowledge among all participants.

2.1. One-shot public goods game

We used the one-shot public goods experiment based on the strategy method as developed by Fischbacher *et al.* (2001). In the experiment, the following linear payoff function for subject i was used:

$$\pi_i = 20 - c_i + 0.4 \sum_{j=1}^{4} c_j, \quad (1)$$

where c_i denotes the contribution of subject i to the public good. Each group consists of four randomly matched subjects, and each subject receives an endowment of 20 experimental points. Each experimental point was exchanged for 0.33 euro. The marginal per capita return (MPCR) from investing in the public good is 0.4. Assuming that participants are rational and selfish, it is obvious that any MPCR < 1 yields a dominant strategy for every group member to free-ride, i.e., to contribute nothing to the public good. From a social perspective, it is optimal to contribute the whole endowment because MPCR•n > 1.

The details of the preference elicitation and the incentive mechanism in our experiment follow Fischbacher *et al.* (2001). Subjects are asked to make two decisions: first, an unconditional contribution to the public good, and thereafter a conditional contribution (a contribution schedule). The unconditional contribution is a single integer number that satisfies $0 \leq c_i \leq 20$. For the conditional contributions, subjects have to indicate how much they would contribute to the public good for any possible average contribution of the three other players within their group (rounded to integers). For each of the 21 possible averages ranging from 0 to 20 points, subjects must decide on a contribution between and including 0 and 20 (strategy method).

To ensure incentive compatibility, both the unconditional as well as the conditional contribution are potentially payoff relevant. For one group member in each group, who is randomly determined by the roll of a four-sided die,[3] the conditional contribution is relevant, whereas the unconditional contributions are relevant for the other three group members. More specifically, the three unconditional contributions within a group and the corresponding conditional contribution (for the specific average of the three unconditional contributions) determine the sum of money contributed to the public good. Individual earnings can then be calculated according to equation (1).

Furthermore, subjects were asked to guess the average unconditional contribution of the other three group members (rounded to integers). The guessing stage is implemented after the contribution stages and was not mentioned in the instructions. As in Gächter and Renner (2010), subjects were monetarily rewarded depending on the accuracy of their guesses. However, we use a slightly different and stronger incentive mechanism. If a subject's guess equals exactly the average unconditional contribution of the other three group members, the

[3] Each group member is assigned a number from one to four. The dice is rolled by a randomly selected participant in the session and monitored by the experimenter.

subject earns 9 points from the guess; if there is a difference of 1 between the guess and the average, 6 points are earned; and a difference of 2 results in 3 points earned. Larger differences are neither rewarded nor punished.

2.2. Elicitation of natural risk attitudes

In the second part of the experiment, we used the design by Holt and Laury (2002) to measure individual risk attitudes. Each subject makes ten risky decisions without interacting with another player. In each decision they choose between Option X and Option Y, where both options include a lottery with the same probabilities but different payoffs. Option X is the relatively safer option because both possible lottery outcomes are between the outcomes of option Y. Throughout the decisions, the payoffs are fixed, but the probability of receiving the higher payoff increases by 10 percentage points from 10% in decision 1 to 100% in decision 10 in both options. The exact amounts of money that we used can be found in appendix B.

Depending on the subject's risk attitude, the subject should, moving down the decisions, switch at some point from Option X to Option Y (or in the unlikely case of extreme risk-loving always choose Option Y). Switching from Y to X or choosing always X is incompatible with consistent behavior since in the last choice option Y for sure results in a higher payoff than Option X. The point at which subjects switch from Option X to Option Y can then be used to calculate the degree of risk aversion. One of the ten lottery choices was randomly selected and played for real. Subjects could earn up to 3.85 euro in this part.

2.3. Trust game

The trust experiment followed the classical design by Berg *et al*. (1995), but each subject played both the role of sender and receiver (such as, for instance, in Burks *et al.*, 2003). In the experiment, the sender is given an endowment of 20 experimental points, and he or she decides how much of the endowment (in integers) to send to the receiver. The amount sent by the sender is tripled before it reaches the receiver. The receiver finally decides on how much to return to the sender (the returned amount is not tripled). A rational and selfish individual would send nothing to the receiver, as backward induction implies that a payoff-maximizing receiver has no incentive to send anything back. There is, however, a possibility for a Pareto improvement if the receiver returns at least one third of the tripled amount received.

The amount sent by the sender is typically seen as an indication of trust, whereas the amount returned by the receiver is a measure of the level of trustworthiness. Since we wanted to obtain trust measures for all subjects, all participants had to make decisions in both roles without knowing which role they would finally be playing. In the role of receiver, we used the strategy method like in the public goods part, i.e., subjects were asked to indicate how much they would send back for all the 21 possible amounts that they could receive.

For determining monetary payoffs, we randomly matched subjects into pairs with randomly assigned actual roles of senders and receivers. The monetary payoff was then determined by subjects' decisions, i.e., the amount sent by the sender and the amount indicated to send back by the receiver conditional on the amount sent. Each experimental point in the trust game was exchanged for 0.33 as in the public goods part.

2.4. Procedure

The computer-based experiments were conducted at the experimental laboratory MELESSA of the University of Munich in October 2009 and March 2010 using the experimental software z-Tree (Fischbacher, 2007) and the organizational software Orsee (Greiner, 2004). A total of 144 undergraduate students from all disciplines except economics participated in six sessions with 24 participants each. The sessions lasted up to 1½ hours, and the average payoff was 16.98 euro, including a show-up payment of 4.00 euro.

An experimental session started with instructions for the public goods game. At that time, subjects received instructions only for the public goods game, but they knew that there would be two more parts in the experiment and that these parts would be unrelated to the public goods game as well as to each other. Subjects received written instructions, which were read aloud, and they had the opportunity to ask questions in private. The public goods game only began when all subjects correctly understood the procedures and after all subjects had passed through some computerized exercises, where they had to compute profits for different contribution levels in the game. At the end of the public goods part, beliefs about others' contributions were elicited. Upon completion, subjects received instructions for the second part, the risk attitude elicitation part, and finally, after the risk elicitation part, for the trust part. These instructions were read aloud, and plenty of time was given to ask questions in private. We also took care that the matching of groups in the public goods game and the trust game was different, and this was clearly stated in the instructions. As already mentioned, the decisions and results of the different parts were only revealed at the end of the entire experiment to avoid any effects from earnings in one part on behavior in subsequent parts. Before payment, subjects answered a post-experimental questionnaire, among others including some questions related to socio-economic factors. Finally, subjects were paid privately in cash and then were free to leave.

3. Results

We start with the presentation of descriptive results. Note that we have excluded twelve subjects from our analysis that did not provide consistent answers in the risk experiment (i.e., that did switch back from Option Y to Option X, which is incompatible with consistent behavior). The average unconditional contribution to the public good is 6.83 points (34.2% of the endowment) and the corresponding guessed contribution by others is 7.32 points (36.6%). These levels correspond well to previous findings in German-speaking countries (e.g., Fischbacher and Gächter, 2010; Fischbacher *et al.*, 2001; Kocher *et al.*, 2008). In the trust game, 7.59 points are on average sent by the sender, and the corresponding level of 38.0% of the endowment as transfers to the responder also corresponds to what has been previously found (e.g., Cardenas and Carpenter, 2008). In the risk experiment, Option X is chosen on average 6.23 times. A risk-neutral subject would choose Option X four times, and thus our data indicate that subjects are on average risk averse. Our findings regarding risk are very similar to the results found by Holt and Laury (2002).

Using the design by Fischbacher *et al*. (2001), we categorize subjects into different types of contributors based on their submitted conditional contribution schedule. If a subject's own conditional contribution increases weakly monotonically with the average contribution of the other members, the subject is classified as a c*onditional cooperator*. Moreover, a subject is classified as a conditional cooperator if the relationship between own and others' average contributions is positive and significant at the 1% significance level based on the Spearman rank correlation coefficient (see the classifications used in, e.g., Fischbacher *et al*., 2001; Fischbacher and Gächter, 2010). *Hump-shaped contributors*, sometimes also called triangle contributors, are subjects who show weakly monotonically increasing (or increasing with a Spearman rank correlation coefficient at the 1% significance level) contributions up to a given level of others' contributions; above that level, their conditional contributions decrease based on a reversed classification as used to the inflection point. A *free rider* is a subject who has a conditional contribution of zero for all levels of the other members' contributions. Finally, those who cannot be categorized into any of the above groups are referred to as *others*.

As shown in Table 1, we find that 19.7% of our subjects can be classified as free riders, 58.3% as conditional cooperators, 11.4% as hump-shaped and 10.6% as others, which again is very similar to the proportions reported in, e.g., Fischbacher *et al.* (2001) and Kocher *et al.* (2008). In columns 3-6 of Table 1, we show descriptive statistics on the behavioral variables that we discussed above for the whole sample but now do separately for each type of contributor. As expected, the unconditional contribution differs significantly at the 1% level between the four types of contributors based on a Kruskal-Wallis test. Conditional cooperators on average contribute 8.18 points unconditionally, whereas free riders only contribute 1.12 points. The average unconditional contributions for the hump-shaped and other types are 6.80 and 10.07 points, respectively.

In Table 1, we have a sub-section in which we only focus on conditional cooperators and free riders for two reasons. First, they exhibit clear and consistent patterns of behavior, and, second, they comprise the majority (78.0%) of types in our sample. Not surprisingly, the unconditional contribution levels differ significantly between free riders and conditional cooperators according to a Mann-Whitney test ($p < 0.01$).

We find similar differences – though smaller in magnitude – between the types when we investigate guessed contributions by others. The free riders on average guessed that others would contribute 4.31 points compared to conditional contributors, who guessed 7.88 points. Therefore, free riders also have a more pessimistic view of cooperativeness of others than conditional cooperators, or they fall prey to the false consensus effect despite the incentivizing of the guess. In any case, we can reject the hypothesis of equality in guessed contributions both for all four types of contributors as well as for a pairwise comparison of free riders and conditional contributors at the 1% significance level. Interestingly, in the trust game, the pattern of transfers is very similar to the contributions in the public goods game. Free riders sent on average 2.58 points, compared to conditional cooperators, who sent 9.06 points. Again, statistical tests reject equality both for all four types of contributors and for a pairwise comparison of free riders and conditional contributors at 1% significance level. However, when it comes to natural risk preferences, there are neither statistically significant differences between the four types of contributors ($p = 0.83$), nor for the pairwise comparison of free riders and conditional cooperators ($p = 0.93$).

Table 1>>>

In the following, we investigate the factors associated with being a specific contributor type using a multinomial logit model. In the analyses, we merge the *hump-shaped* and *others* types to one category *hump-shaped/others*. The three models in Table 2 assess the factors that influence the classification of being a free rider, a conditional cooperator, and being of the residual type. The reference group in the regressions consists of conditional cooperators, and thus the coefficients show how the different variables increase or decrease the likelihood of being classified as a free rider or as hump-shaped/others compared to being classified as a conditional cooperator. We run three models, as we include belief and trust levels both separately as well as together.[4]

We also conducted a regression analyzing whether natural risk is associated with trust because there are significant and positive effects reported in previous research (e.g., Schechter, 2007). Such an analysis is important to decide whether we should allow for the effect in our econometric models. However, risk was insignificant at the 5% level ($p = 0.38$), and thus we only investigate the direct effect of risk on the likelihood of being of one of the types.

In all three models of Table 2, the coefficients of trust and beliefs are significantly negative for free riders at the 5% significance level. In other words, both lower levels of trust as well as lower levels of beliefs in others' contributions are associated with being classified as a free rider. In line with the descriptive results, natural risk does not significantly affect the likelihood of being classified as a certain type.

Table 2>>>

In Table 3, we show the results of how unconditional contributions in the public goods game are associated with belief, trust and natural risk preferences. Trust and beliefs are clearly associated with unconditional contribution behavior. In Model 1 of Table 3, where we included the stated belief together with natural risk, the belief is significant ($p < 0.01$). In Model 2, we included trust instead of the belief, and trust is significant in the regression ($p < 0.01$). In the third regression, where both belief and trust are included, we find that only the belief is significant at the 5% level ($p < 0.01$). However, trust and the stated belief in others'

[4] As discussed in Thöni *et al.* (2009), there is an intuitively obvious correlation between trust and the stated belief regarding others' contribution: somebody who trusts others should have higher expectations in the cooperativeness of others. We follow the approach of Thöni *et al.* (2009) by estimating models that include only beliefs or trust to avoid potential issues of multicollinearity and models that include both.

contributions are clearly associated. In contrast, when using the risk measure from the natural risk experiment task as an independent variable in a regression, the risk coefficient is insignificant in all models again. Therefore, natural risk preferences do not seem to influence behavior in the public goods game.

Yet another way of looking at the association between natural risk and cooperation is to compare implied unconditional contributions with actual unconditional contributions. Implied unconditional contributions are defined as the unconditional contribution one would expect from an individual taking his or her beliefs about others' average contributions and the according number in the contribution schedule. If somebody, for instance, expects an average contribution of the other three group members of 5 points, and if the same person indicates in the contribution schedule that he or she is going to contribute 3 points to the public good in case the average contribution of others is 5 points, then the implied unconditional contribution is 3 points. Because the contribution table is completely deterministic and thus risk-free – one can condition one's contribution on the contribution of others, and there is no uncertainty involved – the implied unconditional contribution includes the assumption of correct beliefs. If conditional cooperators are not entirely sure about their guesses and are on average risk averse, one could expect that the average implied unconditional contribution should be higher than the average actual unconditional contribution because the latter involves social risk. This is, however, not the case at all in our data. If anything, on average actual unconditional contributions are slightly higher than average implied unconditional contributions for conditional cooperators.[5]

Table 3>>>

From our trust experiment part we also have measures for the trustworthiness of subjects. Any conceivable measure of trustworthiness based on the response vector is highly correlated with trust levels. Indeed, if we include the most forward measure of trustworthiness (the amount sent back for the average amount sent, i.e., 8 points) in our regressions, our results do not change. When both trust and trustworthiness are used in the same model, trustworthiness partially takes away significance from the coefficient for trust due to the correlation. These results are robust with regard to the specific metric used to capture trustworthiness.

[5] Note that they should be and are actually the same for free riders.

4. Conclusion

By using a laboratory experiment, we have investigated how beliefs about others' contributions, trust, and risk preferences together play a role in shaping contributions in a public goods experiment. According to Fischbacher *et al.* (2001), we classify subjects into different contribution types. Previous findings documenting that conditional cooperation is a widespread behavioral type are supported by our experimental results. We further find that beliefs about others' contributions and trust elicited by a trust game are significantly associated with public good contributions, whereas natural risk preferences neither affect contributions to the public good nor affect trust behavior in our experiment. Our findings regarding the correlation between trust and cooperation are similar to those in Thöni *et al.* (2009) despite the fact that we use an incentivized game.

The result that trust and cooperation are highly correlated is not surprising. It is intuitively clear that voluntary contribution to a public good involves a certain level of trust in the contribution of others. The association between trust and cooperation can be seen in both actual trusting behavior and in stated beliefs. Interestingly, free riders not only contribute and trust less but also have less optimistic expectations about other' contributions, in line with the false consensus effect.

It is surprising that the attitude towards natural risk does not seem to play a role at all in shaping trust or in explaining cooperation in our experiments. It seems that social risk in a contribution decision is indeed something fundamentally different than natural risk, as has already been indicated by Bohnet *et al.* (2008). However, in contrast to Bohnet *et al.*, we do not find any association between natural risk and trust/cooperation. Of course, we cannot exclude the possibility that our risk measure does not measure actual attitudes towards natural risk. However, we have been using a widely accepted and often used method for eliciting natural risk preferences that has been validated by others.

The literature on trust and the literature on cooperation in economics, specifically in experimental economics, have been distinct to a certain extent. Our results provide another piece of evidence suggesting that one should see them as strongly related concepts and that it would be helpful to further improve the economists' knowledge of the interactions between cooperation, beliefs in others' behavior and trust. For policy makers, our results highlight the importance of high levels of trust as an important ingredient for achieving high degrees of voluntary cooperation in a society. Therefore, this indicates that building trust is an important activity for policies aiming at increasing the contributions to public goods. Such a strategy especially appears to create a virtuous circle of cooperation among the often large number of conditional cooperators, who by their behavior will both contribute more to public goods as well as reduce the speed of decay of contributions to public goods over time (see Fischbacher and Gächter, 2010, on the dynamic effects of the interaction of free riders and conditional cooperators).

Trust building is an important alternative to previously tested institutions in public goods games that have focused on increasing contributions. For instance, monetary punishment (e.g., Bochet *et al.*, 2006; Fehr and Gächter, 2000; Ostrom *et al.*, 1992) and exclusion by voting (e.g., Cinyabuguma *et al.*, 2005) have the potential of substantially increasing contributions to a public good. In the case of monetary punishment, the overall effect on efficiency has shown to be negative in the short run, whereas in the long run, as the degree of punishment decreases over time, the effect is positive (Gächter *et al*., 2008). Trust building in reality is also a costly activity. However, the effect of trust is supposedly more long term compared to the sharp reduction of contributions to public goods when the monetary punishment possibility is revoked (e.g., Fehr and Gächter, 2000). Few of the contribution-enhancing mechanisms have been applied to trust games, and trust has not been considered as a mechanism that one can influence exogenously. However, building trust – even though economists do not yet understand well enough how it works (one study addressing this issue is Näf and Schunk, 2009) – seems to be an interesting alternative mechanism to decentralized sanctioning. Future research in economics could strengthen its focus on trust building and its institutional prerequisites.

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Appendix A: Experimental instructions (originally in German)

Welcome to the experiment and thank you for participating!

Please do not talk to other participants.

General

This is an experiment on economic decision making. You will earn “real” money that will be paid out to you in cash at the end of the experiment. During the experiment all participants will be asked to make decisions. Your decisions and the decisions of other participants determine your earnings from the experiment according to the following rules.

The experiment will last two hours. If you have any questions or if anything is unclear, please raise your hand, and one of the experimenters will come to you and answer your questions privately.

During the experiment a part of your earnings will be calculated in **points**. At the end of the experiment all points that you earn will be converted into euro at the exchange rate of

1 point = 0.33 euro (3 points = 1 euro).

In the interest of clarity, we will only use male terms in the instructions.

Anonymity

You will learn neither during nor after the experiment, with whom you interact(ed) in the experiment. The other participants will neither during nor after the experiment learn, how much you earn(ed). We never link names and data from experiments. At the end of the experiment you will be asked to sign a receipt regarding your earnings which serves only as a proof for our sponsor. The latter does not receive any other data from the experiment.

Means of help

You will find a pen at your table which you, please, leave behind on the table when the experiment is over. While you make your decisions, a clock will run down at the top of your computer screen. This clock will give you an orientation how long you should need to make your decisions. But you can nevertheless exceed this time. The input screens will not be dismissed once time is over. However, the pure output screens (here you do not have to make a decision) will be dismissed.

Experiment

The experiment consists of three parts. You will receive instructions for a part after the previous part has ended. The parts of the experiment are completely independent; decisions in one part have no consequences for your earnings in later parts. The sum of earnings from the different parts will constitute your total earnings from the experiment.

Part I

The decision situation

The basic decision situation will be explained to you in the following. Afterwards you will find control questions on the screen which should raise your familiarity with the decision situation.

You will be a member of a group consisting of **4 people**. Each group member has to decide on the allocation of 20 points. You can put these 20 points into your **private account** or you can put them **fully or partially** into a **group account**. Each point you do not put into the group account will automatically remain in your private account.

Your income from the private account:

You will earn one point for each point you put into your private account. For example, if you put 20 points into your private account (and therefore do not put anything into the group account) your income will amount to exactly 20 points out of your private account. If you put 6 points into your private account, your income from this account will be 6 points. No one except you earns something from your private account.

Your income from the group account:

Each group member will profit equally from the amount you put into the group account. On the other hand, you will also get a payoff from the other group members' in-payments into the group account. The income for each group member out of the group account will be determined as follows:

Income from group account = *Sum of all group members' contributions to the group account × 0.4*

If, for example, the sum of all group members' contributions to the group account is 60 points, then you and the other members of your group each earn 60 x 0.4 = 24 points out of the group account. If the four group members contribute a total of 10 points to the group account, you and the other members of your group each earn 10 x 0.4 = 4 points out of the group account.

Total income:

Your total income is the sum of your income from your private account and that from the group account:

Income from your private account (= 20 – contribution to group account) *+ Income from group account (= 0,4 × sum of contributions to group account)* *= Total income*

Before we proceed, please try to solve the control questions on your screen. If you want to compute something, you can use the Windows calculator by clicking on the respective symbol on your screen.

Procedure of Part I

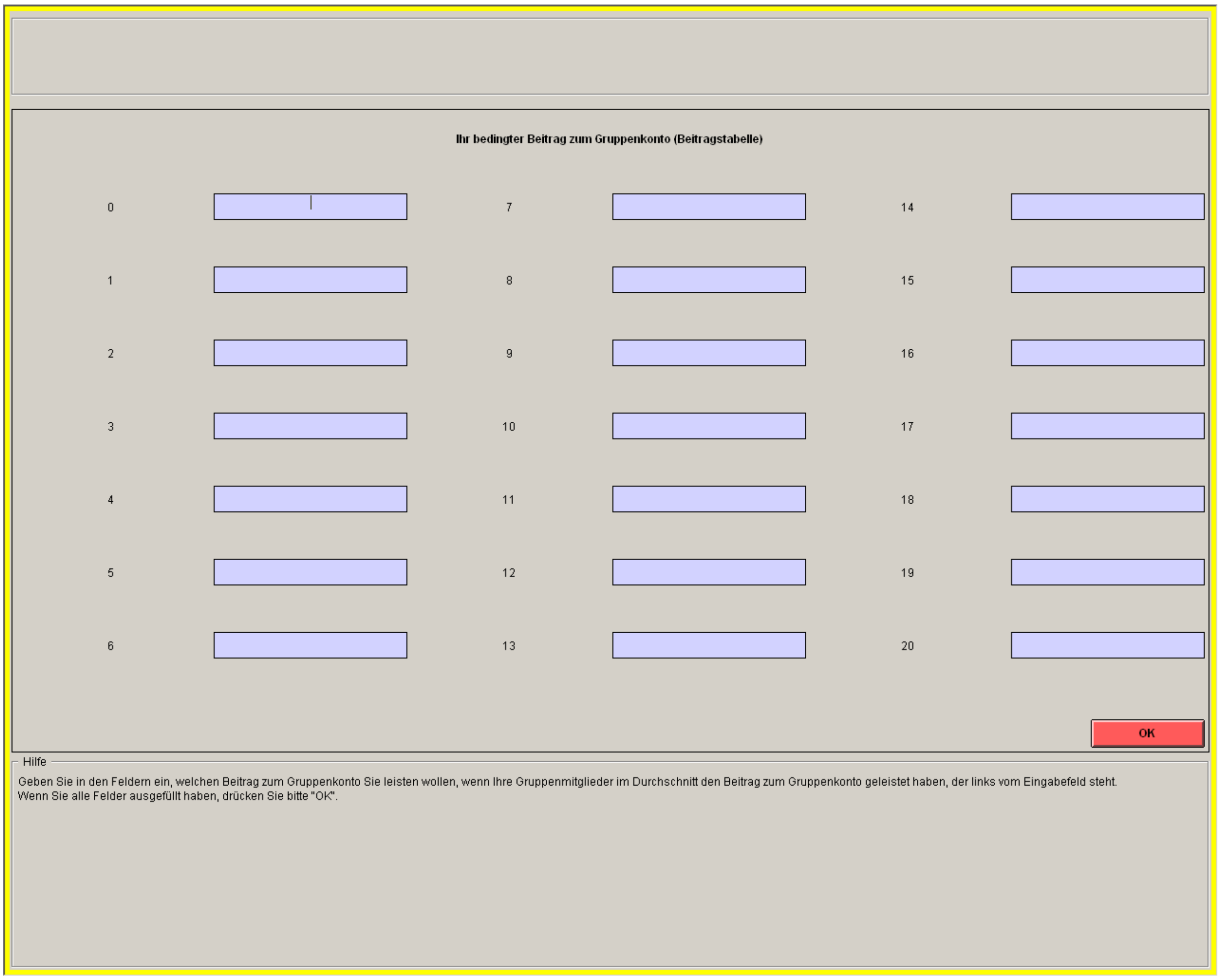
Part I includes the decision situation just described to you. The decisions in Part I will only be made **once**.

On the first screen you will be informed about your **group membership number**. This number will be of relevance later on. If you have taken note of the number, please click "next".

Then you have to make your decisions. As you know, you will have 20 points at your disposal. You can put them into your private account or you can put them into the group account. Each group member has to make **two types** of contribution decisions which we will refer to below as the **unconditional contribution** and the **contribution table**.

- In the **unconditional contribution** case you decide how many of the 20 points you want to put into the group account. Please insert your unconditional contribution in the respective box on your screen. You can insert integer numbers only. Your contribution to the private account is determined automatically by the difference between 20 and your contribution to the group account. After you have chosen your unconditional contribution, please click "next".

- On the next screen you are asked to fill in a **contribution table**. In the contribution table you indicate **how much <u>you</u> want to contribute to the group account for each possible average contribution of the <u>other</u> group members** (rounded to the next integer). Thus, you can condition your contribution on the other group members' average contribution. The contribution table looks as follows:



The numbers in each of the left columns are the possible (rounded) average contributions of the **other** group members to the group account. This means, they represent the amount each of the other group members' has put into the group account on average. You simply have to insert into the input boxes how many points you want to contribute to the group account – conditional on the indicated average contribution. **You have to make an entry into each input box**. For example, you will have to indicate how much you contribute to the group account if the others contribute 0 points to the group account on average, how much you contribute if the others contribute 1, 2, or 3 points on average, etc. You can insert any integer numbers from 0 to 20 in each input box. Once you have made an entry in each input box, please click "OK".

After all participants of the experiment have made an unconditional contribution and have filled in their contribution table, a random mechanism will select a group member from every group. Only **the contribution table** will be the payoff-relevant decision for the **randomly determined subject**. Only the **unconditional contribution** will be the payoff-relevant decision for the **other three group members** not selected by the random mechanism. You obviously do not know whether the random mechanism will select you when you make your unconditional contribution and when you fill in the contribution table. You will therefore have to think carefully about both types of decisions because both can become relevant for you. Two examples should make this clear.

<u>Example 1:</u> Assume that **the random mechanism selects you. This implies that your relevant decision will be your contribution table**. The unconditional contribution is the relevant decision for the other three group members. Assume they made unconditional contributions of 0, 2, and 5 points. The average rounded contribution of these three group members, therefore, is 2 points ((0+2+5)/3 = 2.33).

If you indicated in your contribution table that you will contribute 1 point to the group account if the others contribute 2 points on average, then the total contribution to the group account is given by 0+2+5+1=8 points. All group members, therefore, earn 0.4×8=3.2 points out of the group account plus their respective income from the private account.

If, instead, you indicated in your contribution table that you would contribute 19 points if the others contribute two points on average, then the total contribution of the group to the group account is given by 0+2+5+19=26. All group members therefore earn 0.4×26=10.4 points out of the group account plus their respective income from the private account.

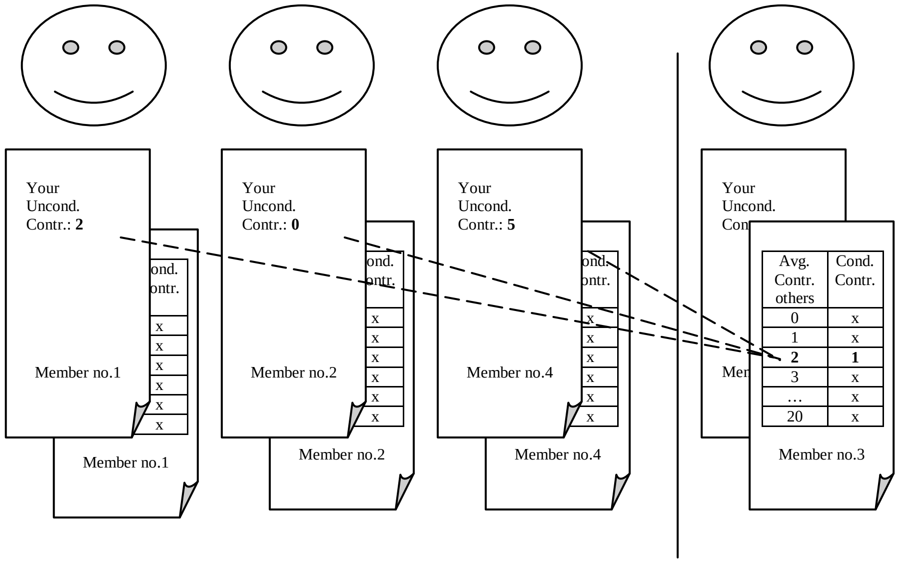
<u>Example 2:</u> Assume that **the random mechanism did not select you,** implying that **the unconditional contribution is taken as the payoff-relevant decision** for you and two other group members. Assume your unconditional contribution to the group account is 16 points and those of the other two group members are 18 and 20 points. The average unconditional contribution of you and the other two group members, therefore, is 18 points (= (16+18+20)/3).

If the group member whom the random mechanism selected indicates in her contribution table that she will contribute 1 point to the group account if the other three group members contribute on average 18 points, then the total contribution to the group account is given by 16+18+20+1=55 points. All group members will therefore earn 0.4×55=22 points out of the group account plus their respective income from the private account.

If, instead, the randomly selected group member indicates in her contribution table that she contributes 19 points to the group account if the others contribute on average 18 points, then the total contribution to the group account is given by 16+18+20+19=73 points. All group members will therefore earn 0.4×73=29.2 points out of the group account plus their respective income from the private account.

The random selection of the participants will be implemented as follows. A randomly selected participant will throw a 4-sided dice **after** all participants have made their unconditional contribution and have filled in their contribution table. She enters the thrown number into the computer thereby being monitored by the experimenter who confirms the correctness of the entry by password. The thrown number will then be compared with the group membership number, which was shown to you on the first screen. If the thrown number equals your group membership number, then your contribution table is payoff-relevant for you and the unconditional contribution is payoff-relevant for the other three group members. Otherwise, your unconditional contribution is the relevant decision for you.

The following figure visualizes the situation in example 1. You are the person on the right side with group membership number 3. Number 3 was thrown and therefore your conditional contribution is payoff-relevant. For the other three group members the unconditional contribution is payoff-relevant.



You will make all your decisions only **once**. After the end of Part I you will get the instructions of Part II. How much you have earned in Part I will be revealed at the end of the experiment.

Part II

(handed out after completion of Part 1)

In Part II you will receive **10 decision problems**. You do not interact with another person in this part. In each of the problems you can choose between **two alternative lotteries**. Your decisions are only valid after you have made a decision for all problems and after you have clicked on the OK-button in the lower part of your screen. Take your time for your decisions because your choice determines your earnings from the second part according to the rules described below.

Here is an example for such a decision problem:

Lottery X	**Lottery Y**	**<u>Your choice</u>**
You receive 2 EUR with probability 8/10 or 1.60 EUR with probability 2/10	You receive 3.85 EUR with probability 8/10 or 0.10 EUR with probability 2/10	□ Lottery X □ Lottery Y

Your earnings will be determined in the following way: First, the computer chooses one of the 10 decision problems randomly and with equal probability. The lottery that you chose for this decision problem will then be simulated in the way that the computer draws a random number between 0 and 10.

For example: Assume that the computer randomly chooses the decision problem from the table above, and your choice was lottery X. Then, the computer simulates lottery X, and you receive either 2 EUR (with probability 8/10 = 80%) or 1.60 EUR (with probability 2/10 = 20%) as your earnings from Part II of the experiment. You will receive the high payoff if the randomly chosen number is smaller or equal to 8 (80% probability) and the low payoff if the random number is bigger than 8 (20% probability).

If, however, the computer chooses a decision problem with a 40% probability of receiving the high payoff, then each random number below or equal to 4 will result in the high payoff whereas all numbers bigger than 4 lead to the low payoff, etc.

Please note that we are talking about euro-amounts here and not about points! The euro-amount that you will earn in Part II will be added to the in euro converted points from the other parts.

You will make your decisions only **once**. After the end of Part II you will get the instructions of Part III. How much you have earned in Part II will be revealed at the end of the experiment.

Part III

(handed out after completion of Part I1)

The decision situation

At the beginning of Part III all participants will be randomly matched into **groups of two**. In each pair **both participants will slip into the roles A and B**. Afterwards, it will be determined randomly for whom role A and for whom role B is payoff-relevant. **Your interaction partner will be no one who was member of your group in Part I**! On the screen you first have to make decisions in the role of participant A and afterwards in the role of participant B.

Participant A has an endowment of 20 points. Participant B has no endowment. Participant A has to decide how many of the 20 points she wants to send to participant B. **She can send every integer number X between 0 and 20** (0 and 20 are also possible). Participant A will keep the residual (20-X), while the **amount X sent to participant B is tripled**. This means that for each point participant A sends to B, B will receive three points.

Participant B has to decide how many points of the tripled amount she wants to send back to A. **She can send back every integer number Y between 0 and 3X** (0 and 3X are also possible). Participant B will keep the residual (3X-Y). Note, that the **amount Y sent back to participant A is not tripled.**

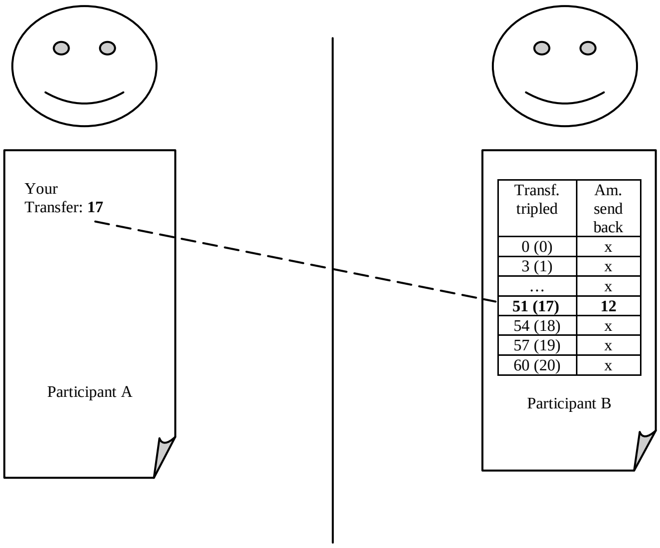
Procedure of Part III

In each pair both subjects will first slip into role A and afterwards into role B. In the role of participant A you will decide about the transfer to participant B. In the role of participant B you will decide how much you want to send back to A for each possible integer transfer between 0 and 20. The corresponding screen will look as follows:

On the left side of each input box you can see the amount that you have at your disposal. This amount is three times the transfer by participant A. The transfer of participant A itself is denoted in brackets. If you want to compute something, you can click on the calculator symbol.

After all participants of the experiment have chosen a transfer and have filled in the table, the computer will determine randomly which group member is assigned to role A and role B respectively. Payoff-relevant then are only the decisions made in the assigned roles. This means in particular that the value extracted from the contribution table is the value the person in role B has chosen for the actual transfer of the person in role A.
When you make your decisions you do not know whether role A or role B will be payoff-relevant for you. Therefore it is reasonable to think carefully about your decisions in both roles.
As a reminder, here are the payoffs for both participants: A will receive the residual of her endowment (20-X) plus the amount Y sent back by B (in sum: 20-X+Y). B will receive three times the amount sent by A (3X) minus the amount Y sent back to A (in sum: 3X-Y).

As an example, please consider the following figure. The figure shows the transfer of participant A (17). In this case participant B obtains 51 points (17x3). From these 51 points she sends 12 points back to participant A.



You will make your decisions only **once**. At the end of the experiment you will learn your payoff-relevant role and how much you have earned in Part III.

After Part III is finished we will ask you to fill in a short questionnaire on the screen. Afterwards you will learn for each part separately how much you have earned. Then the experiment ends. There are neither more parts nor any repetitions. Finally, you will be informed about your total earnings from the experiment and paid out.

Appendix B: Measuring individual risk attitudes with the Holt and Laury (2002) design

Table B1. The ten paired lottery-choice decisions.

Option X	**Option Y**	**Expected payoff difference**
1/10 of €2.00, 9/10 of €1.60	1/10 of €3.85, 9/10 of €0.10	€ 1.17
2/10 of €2.00, 8/10 of €1.60	2/10 of €3.85, 8/10 of €0.10	€ 0.83
3/10 of €2.00, 7/10 of €1.60	3/10 of €3.85, 7/10 of €0.10	€ 0.50
4/10 of €2.00, 6/10 of €1.60	4/10 of €3.85, 6/10 of €0.10	€ 0.16
5/10 of €2.00, 5/10 of €1.60	5/10 of €3.85, 5/10 of €0.10	-€ 0.18
6/10 of €2.00, 4/10 of €1.60	6/10 of €3.85, 4/10 of €0.10	-€ 0.51
7/10 of €2.00, 3/10 of €1.60	7/10 of €3.85, 3/10 of €0.10	-€ 0.85
8/10 of €2.00, 2/10 of €1.60	8/10 of €3.85, 2/10 of €0.10	-€ 1.18
9/10 of €2.00, 1/10 of €1.60	9/10 of €3.85, 1/10 of €0.10	-€1.52
10/10 of €2.00, 0/10 of €1.60	10/10 of €3.85, 0/10 of €0.10	-€1.85

Note that risk neutral people choose option X for the first four lotteries and switch to option Y afterwards. Risk averse people will switch to option Y later whereas risk-loving individuals switch to Y before the fourth lottery.

Table 1. Descriptive statistics of the experiment and non-parametric tests (n = 132).

Type of subject	**Proportion of subjects**	**Unconditional contribution**	**Guessed contribution by others**	**Amount sent (trust game)**	**Natural risk**
Free riders	19.7%	1.12	4.31	2.58	6.27
Conditional cooperators	58.3%	8.18	7.88	9.06	6.30
Hump-shaped contributors	11.4%	6.80	8.00	8.80	5.73
Others	10.6%	10.07	9.07	7.50	6.29
H0: No difference between types (Kruskal-Wallis test (p-value))		<0.01	<0.01	<0.01	0.83
H0: No difference between free riders and conditional cooperators (Mann-Whitney test (p-value))		<0.01	<0.01	<0.01	0.93
All types	100%	6.83	7.32	7.59	6.23

Note: Twelve subjects with inconsistent risk preferences are excluded.

Table 2. Estimation results from multinomial logit model – contributor type.

Dependent variable: Contributor type	**Model 1**		**Model 2**		**Model 3**	
	Free riders	**Hump-shaped/ Others**	**Free riders**	**Hump-shaped/ Others**	**Free riders**	**Hump-shaped/ Others**
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
Belief about others' contribution	-0.282***	0.035	-	-	-0.215**	0.052
	(0.079)	(0.047)			(0.082)	(0.050)
Trust	-	-	-0.244***	-0.026	-0.203***	-0.038
			(0.087)	(0.030)	(0.088)	(0.033)
Natural risk	0.055	-0.121	-0.032	-0.132	0.059	-0.135
	(0.140)	(0.149)	(0.154)	(0.142)	(0.156)	(0.149)
Constant	0.234	-0.518	0.406	0.062	0.886	-0.246
	(0.950)	(1.077)	(1.055)	(0.943)	(1.029)	(1.093)
Number of observations	132		132		132	

Note: *** denotes significant at the 1% level, ** at the 5% level and * at the 10% level. Robust standard errors in parentheses. The reference group is conditional cooperators.

Table 3. Estimation results from OLS model – unconditional contributions.

Dependent variable: Unconditional contribution	**Model 1**	**Model 2**	**Model 3**
	Coeff.	Coeff.	Coeff.
Belief about others' contribution	1.105***	-	1.056***
	(0.067)		(0.084)
Trust	-	0.349***	0.086
		(0.091)	(0.069)
Natural risk	0.094	0.178	0.120
	(0.225)	(0.335)	(0.225)
Constant	-1.839	3.073	-2.295
	(1.379)	(2.209)	(1.393)
Number of observations	132	132	132

Note: *** denotes significance at the 1% level, ** at the 5% level and * at the 10% level. Robust standard errors in parentheses. The results are very similar for a tobit regression model.